IS 5461 (1984): Method for sieve analysis of metal powders
[MTD 25: Powder Metallurgical Materials and Products]

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(Reaffirmed 2002)

# *Indian Standard*

# METHOD FOR SIEVE ANALYSIS OF METAL POWDERS

## *( First Revision )*

UDC 669-492·2 : 620·168·32



INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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# *Indian Standard*

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## *( First Revision )*

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# *Indian Standard*

# METHOD FOR SIEVE ANALYSIS OF METAL POWDERS

## *( First Revision )*

## 0. FOREWORD

**0.1** This Indian Standard ( First Revision ) was adopted by the Indian Standards Institution on 21 February 1984, after the draft finalized by the Powder Metallurgical Materials and Products Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** This standard was first published in 1969. On the basis of experience gained by the indigenous industry in the field of powder metallurgy, the concerned Sectional Committee decided to undertake the revision.

**0.3** In this revision the details to be given while reporting the results, have been included ( *see* **9** ).

**0.4** For the convenience of the users, comparable foreign standards are given below:

a) ASTM B 214-76
b) DIN 81-69
c) MPIF 05, 1973
d) ISO 4497-1983

**0.5** In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

## 1. SCOPE

**1.1** This standard prescribes the method for sieve analysis of dry unlubricated metallic powders. The method is not applicable to powders in which the morphology differs markedly from being equiaxial and the particle size wholly or mostly under 45 $\mu$m.

*Rules for rounding off numerical values ( *revised* ).

## 2. TERMINOLOGY

**2.1** For the purpose of this standard, the definitions given in IS : 5432-1982* shall apply.

## 3. PRINCIPLE OF TEST

**3.1** This test consists of separation of the powder into particle size fractions by shaking through a set of wire cloth, test sieves arranged in consecutive order of size of aperture openings and weighing the fractions retained on each sieve.

## 4. TESTING APPARATUS

**4.1 Sieves** — A set of standard sieves ( *see* Table 1 ) conforming to IS : 460 ( Part 1 )-1978†.

The test sieve frames shall rest singly with one another and the set shall be completed with a lid on top and a collecting pan below the bottom sieve.

**TABLE 1 STANDARD SIEVE SET**

| Sieve Designation |
|---|
| μm |
| 180 |
| 150 |
| 125 |
| 106 |
| 90 |
| 75 |
| 63 |
| 53 |
| 45 |

NOTE — The nearest equivalent mesh are 80 ( 180 μm ), 100 ( 150 μm ), 150 ( 106 μm ), 200 ( 75 μm ) and 325 ( 45 μm ).

**4.2 Sieve Shaker** — A mechanically operated sieve shaker with following details may be used:

| | |
|---|---|
| Number of revolutions | 270-300/min |
| Number of tappings | 140-160/min |

*Glossary of terms relating to powder metallurgy ( *first revision* ).
†Wire cloth test sieves ( *second revision* ).

| | |
|---|---|
| Hammer mass | 3 kg |
| Amplitude | 30 mm |
| Free falling height of hammer | 60 mm |

The sieve shaker shall be fitted with a plug to receive the impact of tapping device.

**4.3 Balance** — A balance having a sufficient capacity to weigh 100 g of powder to an accuracy of ±0·01 g.

## 5. SAMPLING

**5.1** Sampling shall be carried out in accordance with IS : 6492-1972*.

**5.2** In general the powder shall be tested in the as-received condition. In certain instances, the powder may be dried at temperature 110 ± 5°C for 1 hour. However, if the powder is susceptible to oxidation, the drying should take place in an inert gas.

## 6. TEST SPECIMEN

**6.1** The size of the test specimen shall be 100 g for any metal powder having an apparent density greater than 1·5 g/cc when determined in accordance with IS : 4848-1981†. A 50 g specimen shall be used when the apparent density of the powder is less than 1·5 g/cc.

## 7. TEST PROCEDURE

**7.1** The group of sieves selected shall be assembled in consecutive order as to size of openings with the coarsest sieve at the top, the assembly being completed by a collecting pan below the bottom sieve. The test specimen shall be placed on the top sieve and this sieve closed with a cover. The sieve assembly shall then be fastened securely in a suitable mechanical sieve shaking device and the machine operated for a period of 15 minutes.

**7.2** The screened fractions shall be removed from the nest of sieves by removing the coarsest sieve from the nest gently tapping its contents to one side and pouring them upon a glazed paper. Any material adhering to the bottom of the sieve and frame shall be brushed with a soft brush into the next finer sieve. The sieve just removed shall be tapped, upside down, on the paper containing the portion that had been retained on it. This fraction shall be weighed to the nearest 0·1 g. This process shall

*Methods for sampling of powders for powder metallurgical purposes.

†Method for determination of apparent density of powders for powders metallurgical purposes (*first revision*).

be repeated for each sieve in the nest and the fraction collected in the pan shall also be removed and weighed. The sum of the masses of all the fractions shall not be less than 99 percent of the mass of test specimen, and the difference between this sum and the mass of the test specimen shall be added to the mass of the fraction collected in the pan.

**7.3** The standard sieves will, after a period of time will become less accurate. The sieves shall, therefore, be periodically checked and the correction factor to be applied to the results shall be determined. The method of checking of sieves is illustrated in Appendix A.

## 8. TEST RESULTS

**8.1** The masses of the fractions retained on each sieve and the mass of the fraction collected in the pan shall be expressed as percentages of the mass of the test specimen to the nearest 0·1 percent, and reported in the form shown in Table 2. Any fraction, that is less than 0·5 percent of the mass of the test specimen, shall be reported as 'trace'.

**TABLE 2 REPORTING OF TEST DATA**

| Retained on Sieve | Passing Sieve | Percent by Mass |
|---|---|---|
| μm | μm | |
| (1) | (2) | (3) |
| 180 | — | — |
| 150 | 180 | — |
| 125 | 150 | — |
| 106 | 125 | — |
| 90 | 106 | — |
| 75 | 90 | — |
| 63 | 75 | — |
| 53 | 63 | — |
| 45 | 53 | — |
| — | 45 | — |

### 8.2 Precision

**8.2.1** *Repeatability* — The results of tests on the same sample, by the same operator using same apparatus shall not be considered suspect unless values differ by ±3 percent.

**8.2.2** *Reproducibility* — The results of tests on the same sample in different laboratories should not be considered suspect unless the values differ by ± 10 percent.

## 9. TEST REPORT

**9.1** The test report shall include the following informations:

a) Reference to IS : 5461-1984;

b) All details necessary for identification of the test sample;

c) The drying procedure, if the powder has been dried; and

d) The results obtained.

# APPENDIX A

( *Clause* 7.3 )

## CHECKING OF SIEVES AGAINST A STANDARD SET

**A-1.** When used continually, the sieves in a set, after a period of time, will become less accurate and might no longer be acceptable as certified sieves. These sieves shall be checked against a master set of standard sieves by comparing sieve tests on the same sample, run in both the master set and the working set. A correction factor shall be established as shown in Table 3, and all results obtained on the working sieves shall be multiplied by the factor so obtained before reporting.

**TABLE 3 EXAMPLES OF METHOD FOR OBTAINING SIEVE CORRECTION FACTOR**

| Retained on Sieve | Passing Sieve | Results Obtained on Certified Sieve | Results Obtained on Worknig Sieve | Correction Factor |
|---|---|---|---|---|
| ( 1 ) | ( 2 ) | ( 3 ) | ( 4 ) | ( 5 ) |
| µm | µm | | | |
| 180 | — | — | — | — |
| 150 | 180 | a | b | a/b |
| 125 | 150 | c | d | c/d |
| 106 | 125 | e | f | e/f |
| 90 | 106 | — | — | — |
| 75 | 90 | — | — | — |
| 63 | 75 | — | — | — |
| 53 | 63 | — | — | — |
| 45 | 53 | — | — | — |
| — | 45 | — | — | — |

NOTE — To obtain ' corrected values ' for reporting, multiply the ' correction factor ' with the values obtained in col 4, on the working sieve.

# INTERNATIONAL SYSTEM OF UNITS ( SI UNITS )

**Base Units**

| Quantity | Unit | Symbol |
|---|---|---|
| Length | metre | m |
| Mass | kilogram | kg |
| Time | second | s |
| Electric current | ampere | A |
| Thermodynamic temperature | kelvin | K |
| Luminous intensity | candela | cd |
| Amount of substance | mole | mol |

**Supplementary Units**

| Quantity | Unit | Symbol |
|---|---|---|
| Plane angle | radian | rad |
| Solid angle | steradian | sr |

**Derived Units**

| Quantity | Unit | Symbol | Definition |
|---|---|---|---|
| Force | newton | N | 1 N = 1 kg.m/s$^2$ |
| Energy | joule | J | 1 J = 1 N.m |
| Power | watt | W | 1 W = 1 J/s |
| Flux | weber | Wb | 1 Wb = 1 V.s |
| Flux density | tesla | T | 1 T = 1 Wb/m$^2$ |
| EFrequency | hertz | Hz | 1 Hz = 1 c/s (s$^{-1}$) |
| lectric conductance | siemens | S | 1 S = 1 A/V |
| Electromotive force | volt | V | 1 V = 1 W/A |
| Pressure, stress | pascal | Pa | 1 Pa = 1 N/m$^2$ |

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